BRITISH SUGAR CORPORATION LIMITED

ELY FACTORY

ONE OF THE EIGHTEEN FACTORIES IN GREAT BRITAIN PRODUCING HOME GROWN SUGAR

THE MANAGEMENT OF THE ELY FACTORY WELCOME YOU AS VISTORS, AND HOPE YOUR TOUR WILL PROVE BOTH INTERESTING AND INFORMATIVE.

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ACCIDENT PREVENTION

We are very live to our responsibilities with regard to the safety of our employees and our visitors and have a very active safety programme to help prevent any possibility of an accident.

Please remain with your guide at all times and do not stray from the party.

Obey any instructions that may be given with regard to movement around the Factory end exercise care when crossing Company roads and railways.

Sugar extraction is a wet process in the early stages and you are warned to take particular care when walking over wet patches on tiles and concrete floors.

YOU MAY SMOKE UNLESS TOLD NOT TO BY YOUR GUIDE.

D. Bradford,

General Manager/Agriculturist.

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NOTICE

Visitors tour Ely Sugar Factory at their own risk. Whilst every effort is made to ensure the safety of the individual, British Sugar Corporation Limited cannot be held responsible for any accident, or loss or damage to property, whatsoever, during your time on these premises.

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ELY FACTORY

The crop for this factory is grown by over 1,900 farmers on 30,000 acres in the Counties of Bedford, Cambs. & Isle of Ely, Hunts, Norfolk, and West Suffolk.

The yield averages between 400,000 and 550,000 tons of beet yearly, (between 1½ and 2¾ tons of sugar per acre).

Delivery is normally by road, that is 550 to 650 lorry loads daily.

All consignments are weighed on arrival and a sample for determination of sugar percent and non-beet material (mostly soil) is taken from each.
This operation is carried out in the presence of a National Farmers Union Representative.

Harvesting and delivery usually extends from late September to the end of January.

The Factory can deal with 4,000 / 4,500 tons of beet per day (three eight-hour shifts) with an output of:

500 to 600 tons of Raw Sugar.

300 to 350 tons of Dried Molassed Pulp Nuts (Cattle Food)

150 to 200 tons of Molasses.

Surplus electricity is sold to the Eastern Electricity Board.

THE PROCESS

Tipping lorries discharge into SILOS from the ELEVATED ROADWAY.

ROAD ELFA - Other lorries are unloaded by water power, the roots floating in a stream of water along the FLUMES (concrete ducts) to the BEET PUMPS which pump water and beet 50' from ground level to the BEET WASHER or to wet storage in Silos which, together with the "tipping silos" can hold 12,000 tons of beet. The roots are thoroughly cleaned in the beet washer and then conveyed by scroll and belt conveyor to the BEET HOPPER (capacity 80 tons); next they fall into the CUTTING MILLS or slicers which shred the beet into fine Vee shaped slices (Cossette's); these are weighed in transit on a continuous belt weigher, while being conveyed to the SWIM TROUGH.

From the Swim Trough the Cossette's are flushed by raw juice into the CONTINUOUS DIFFUSER, - a longitudinal drum, divided into 27 compartments, in which sugar is diffused out of the beet slices by hot water(70°C) while they move from one end of the drum to the other in approximately 1½ hours (15-18 revs. per hour). The water is pumped in the reverse direction at twice the speed and emerges from the drum as RAW JUICE.

This diffuser, installed in 1959, is one of the biggest of its kind in the world, and weighs 240 tons.
When dealing with 4,000 tons of beet per 24 hours it contains at any one time, 264 tons of beet and 156 tons of liquid, giving a total weight of 660 tons in all, rotating on 4 trunnions. It is turned by a 110 h.p. motor.

The Cossette's, now called exhausted slices, are conveyed to the PULP PRESSES where much of the moisture is removed. Molasses is added and the mixture passed through the Driers.

PULP DRIERS dry the mixture of Slices and Molasses to about 90% dry matter. It is then passed to the six NUTTING MACHINES – bagged in 1 cwt. Paper sacks, and forms a valuable cattle food "Molassed Sugar Beet Pulp Nuts" (20%-22% Sweetening Matter).

Meanwhile the raw juice from the Diffuser, after further heating, passes to the CARBONATION Tank where Milk of Lime. Ca(0H)2, is added; carbon dioxide (CO2) is next bubbled through the liquid until a precipitate is formed, (CAC03) combining with it any impurities. This precipitate is allowed to settle in a large cylindrical tank of 40,000 gallons capacity, called a CLARIFIER from where it is removed to the rotating DORR OLIVER VACUUM FILTERS. The material is called Lime Cake or Factory Carbonate of Lime and in summer can be taken by farmers to correct acidity in their land. Organic impurities from the beet, including Nitrogen, Phosphate and Potash, have a good manurial value.

2nd CARBONATION TANK

The clear settled juice overflows from the clarifier and is again treated with CO2 for further removal of impurities and filtered in the 2nd Filter Presses.

EVAPORATORS

A number of vessels in which the juice is concentrated by boiling in gradual stages from a liquid of 15% sugar to a syrup of 65% sugar. Boiling commences at 128°C, using steam of 30 lbs. pressure and the juice leaves at 65°C under 20" of vacuum.

VACUUM PANS

The syrup is further concentrated by boiling under vacuum until it becomes supersaturated, crystals are encouraged to form and are grown to the required size by the art of the Sugar Boiler. The mixture of syrup and crystals is called massecuite.

CRYSTALLISERS

Large tanks with a stirring gear in which the massecuite is cooled to permit further growth of the crystals.

MIXER

Container for holding massecuite to supply centrifugal machines.

CENTRIFUGALS

Revolving baskets (1000/1500 r.p.m.) which separate sugar crystals from syrup by centrifugal force. After washing, the sugar is discharged through the bottom of machine, the syrup removed being re-boiled into a lower grade of massecuite which is spun again to separate out the crystals, the final syrup produced being molasses.

SUGAR DRIER

The crystals are cooled and mixed before loading loose into rail trucks or road wagons for immediate dispatch.

DAILY REQUIREMENTS

Coal 280 tons

Limestone 135 tons (Burnt in 2 kilns to produce burnt lime and Carbon Dioxide Gas)

Coke 14 tons

Water 4 million gallons in a closed circuit

POWER

Of the 5,500kw generated hourly by the two Turbo Alternators, 4,250kw per hour, equivalent to the normal amount used by Ely and district, are required to operate the factory, 1,000 to 1,500kw is sold to the Eastern Electricity Board.

The plant runs night and day for 100 to 140 days each season, about 340 people being employed, 66 on each of the 3 shifts plus 140 day workers and office staff.

Ely factory was built in 1924/25, slicing for the first time on the 14th October, 1925, the average for that Campaign being 822 tons of beet daily. However, the new machinery had settled down by the following year and an average of 1,800 tons per 24 hours was attained. After various improvements, capacity was gradually increased, until just before, and during the war, 2,800 tons was the normal throughput. Some white sugar was produced each year until 1943 after which year increase capacity was considered to be more in the Nations interest, and this was possible if only raw sugar was produced. In 1956 a continuous diffuser replaced the more laborious method of sugar extraction and the daily slice went up to the present 4,000 tons daily. On two occasions when there have been potato gluts, surplus potatoes have been dried for meal production during the Spring.

BEET RECEPTION

To regulate the intake in 5½ days of the 30,000 tons of beet needed during the 168-hour week, a system is in operation whereby each grower receives a permit for each load of beet he will deliver. Great pains are taken to see that these are so issued that a regular amount of beet leaves each farm weekly according to the acreage and tonnage of beet grown, the position has to be under constant revision to maintain an even flow of about 600 loads daily. A farmer who misses his early permits penalises himself by having to deliver a higher proportion of his crop at the end of the season.

On arrival at the Factory, the lorry driver presents the correct permit, valid for that day only, on this is printed the name and address of the owner of the beet.

An electronic punched card system of recording is used in the Weighbridges and Tarehouses, the system involves the use of a plastic tab called a "Stub Card", which serves as a means of identifying the load and sample. A separate Stub Card is used for each load. Printed on the Stub Card is a serial number and punched holes in it represents that number. When weight, sugar content, etc., have to be recorded the Stub Card is placed in a reader which, when operated passes a signal to a punch machine that that registers by means of punched holes in a card the Serial Number and the weight, or other information which is being received direct from the recorder.

The lorry is weighed and, using the Stub Card as identification, the weight is recorded by a punch machine on Card No.1, the Stub Card is then passed to the Driver who then drives to the sampling point, hands his Stub Card to the sampler who takes a sample in the agreed manner (See clause 8 of the Beet Contract).

At Ely the "agreed manner" for taking samples is by the mechanical probe sampler There are six different sampling positions in the load (see illustration below), and samples are taken in a randomised sequence not under control of the sample taker.

The sample taken weighs about 1½ cwts. And is then divided into six parts in the "Splitter", one resulting part, accompanied by the Stub Card in a waterproof envelope, is then taken to the Tarehouse and from this point is completely anonymous, each sample being identified by the Stub Card only.

After the lorry has unloaded, either at the Elfa or by tipping from the elevated roadway, it returns to the Weighbridge. The Factory Registration Number displayed on the windscreen identified the lorry, the operator picks up the appropriate cards which include-

a) The permit on which has been hand written the Factory Registration number of the lorry and the number on the Stub Card allotted to this load when weighed in.

b) The punched card from the IN bridge recording the Stub Card number, the gross weight, and the lorry number (Card No.1)

c) The Grower's Record Card which gives all the necessary information relating to the Grower delivering the beet.

Card 1 and the Growers Record Card are placed in a reader and the Start button on the weighing machine is pressed, putting the reader and another punch machine into operation. The latter produces a Card No.2 which gives all the information from Card 1 and Growers Record Card, i.e. Stub Card Number, Contract Number, Name of Grower, the Gross weight of the load together with the tare weight, the method of unloading now recorded, and the lorry number. Coupled to the reader is an electronic typewriter which simultaneously types in duplicate the haulage receipt note, the top copy of which is given to the driver as a receipt for the load.

On both IN and OUT bridges are electric displays of the weights recorded, which are easily checked with the dial by the driver and the Weighman. It is the driver's responsibility to see that the display weight is the same as that shown on the dial of the machine.

In the Tarehouse - The sample is tipped into the "dirty beet scale" and the weight (in ¼ lb. Units) is recorded remotely on punched card No.3.using the stub Card to identify the sample. the recorded weight is shown on an electric display and is checked with the weight shown on the dial by the N.F.U representative and the operator. (Other N.F.U employees are able to watch tear house activities and carry out check analysis of the sugar samples for sugar content). The sample is next to tipped into a Rotary spray washer. The Stub Card travelling on a magnetic rail down to the other end ready to be placed in a reader while the beet are being washed. As the roots appear from the washer they are examined and if necessary re- topped, then placed directly into the clean scale pan where a similar procedure applies as at the "dirty beet scale". When completed, the number, sample weight, number of roots and weight of the tops are recorded on a punch Card No.4 From here the sample travels up an elevator into the multiple saw.

These are seven saws revolving at 480 r.p.m which cut into the beet and remove as "saw dust" a moist mass called "Brei" which after thorough mixing and removal of large pieces is tested for sugar content.

Between 25-27 grammes of the mixed brei are placed on a pan of the Reagent adder which automatically adds the correct proportion of lead acetate and water, depending on the weight of the brei on the pan. The brei and solution are thoroughly mixed in a metal beaker by a mechanical agitator. The mixture is filtered and the clear liquid resulting syphoned into the automatic polarimeter which shows on an electric display the sugar percentage. The Stub Card which has continued to travel with the sample is once more placed in a Stub Card Reader and card No.5 is punched recording the sugar content.

In all, four cards, Numbers,2,3,4 and 5, are needed for each load received; these are forwarded to the Corporation's Central Accounting Department to produce the Grower's advice note and monthly accounts.

On the Grower's Advice Note are shown full details of the load and sample including, Name and Address, Contract Number, Stub Card serial number, Dirt and Top Tares, Sugar Content, Number of Roots in the sample, price per ton and total value of load. This return is despatched to the Grower within four days of the load being delivered.

OTHER INFORMATION ON THE INDUSTRY

In the past five years, this Factory has processed 2,340,000 tons of beet (received 215,000 tons of soil along with them), produced over 290,000 tons of raw sugar, and about 165,000 tons of molassed pulp.

Payment for beet is made monthly (at the rate of £6.16s.6d. per ton in 1968/69 plus or minus 10/- per 1% sugar over or under 16%. A deduction of 4d. per ton is made to defray the cost of the programme of the Research and Education Committee of the Ministry of Agriculture, and a like sum is contributed by the Corporation. 2d. per ton is levied to pay the cost of the Grower's Representatives employed on behalf of farmers by the N.F.U.

The price of dried molasses pulp or Pulp nuts is determined in September in relation to the prevailing price of other feeding stuffs.

The grower of Sugar Beet is able to order up to 1½ cwts. of pulp for every ton of beet delivered. The price of pulp this winter (1968) is £20.5s.0d. per ton ex-Factory.

The white sugar produced by both the British Sugar Corporation and the various refining firms in this country is the 99.97% chemically pure substance known to chemists as sucrose $C_{12}H_{22}O_{11}$ or "Cane Sugar".

The refiners and the Corporation used both sugar from sugar beet and sugar from sugar cane as their raw material. Though naturally, the Corporation's white output is mainly from the beet it processes during the winter months, and cane raws are bought only to make up any deficiency which may occur.

At Ely only raw sugar is produced, (on average 97½% $C_{12}H_{22}O_{11}$) and this is either sold to the refiners for immediate use, sent to other of the Corporation's plants to be refined with their own production, or stored to be refined by them after the beet crop has been dealt with.

Neither humans nor bees, (at least the bees never complain and thrive on either) can differentiate between white sugar produced from sugar cane or from sugar beet unless the humans are able to chemically analyse the minute quantities of other substances present. Extremely specialised methods have to be used, and even then, it would not always be possible to be sure from which plant the sucrose came.

In Great Britain we eat about 116 lbs. of sugar per person per year, mostly in the manufactured food we buy. Nearly 3,000,000 tons of sugar are refined in the British Isles annually, of this, on latest quotas: -

24% will come from the West Indies & Cuba

13% from Mauritius

11% from Australia

8½% from Fiji, British Honduras, Africa & India.

All paid for under the Commonwealth Raw Sugar Agreement at the rate of £43.10s.0d per ton + 30/- Colonial certified preference + a special payment for sugar from developing Countries.

31½% will be supplied by the British Beet Sugar Industry, and the remaining 12% will come in at World Market price either "above quota" from Commonwealth Countries or from other suppliers.